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ABSTRACT

Following a discussion of opportunities for improving academic rigor that addresses the challenges of curriculum redesign, theories of learning and multimedia design, and academic departments and multimedia design, this paper focuses on the migration of an introductory course on library research skills at the University of Nebraska-Lincoln from a self-paced, paper manual to a World Wide Web-based, multimedia platform. The paper covers the following topics: (1) the goals of curriculum redesign, including curricular goals, faculty development goals, and curricular redesign; (2) guiding the redesign process, including providing the theoretical basis and putting theory into practice through content analysis, formative and summative assessment, and content specifications; and (3) outcomes of the redesign effort, including curricular quality and faculty development. (Contains 10 references.) (AEF)

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# Improving Academic Rigor Through Curriculum Redesign

Gail F. Latta, Associate Professor
University of Nebraska-Lincoln

Tracy Bicknell-Holmes, Associate Professor
University of Nebraska-Lincoln

Sara Martin, Assistant Professor
University of Nebraska-Lincoln

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## Opportunities for Improving Academic Rigor

### Challenges of Curriculum Redesign

Redesigning course curriculum for online multimedia delivery requires rethinking student behavioral outcomes, pedagogical techniques, and the role of assessment in fostering student learning. Student outcomes must be rethought in relation to the goals of the course and the characteristics of the student population that is being targeted. Pedagogical techniques must be revised to achieve effective student learning through online, independent study, and to take advantage of the didactic potential of multimedia. The role of assessment should be re-examined to maximize the instructional utility of interactive, formative and summative evaluations for fostering fluency with course content.

### Theories of Learning and Multimedia Design

Inherent in these processes is the opportunity to increase the academic rigor of traditional course offerings utilizing the principles of mastery and discovery learning. Mastery learning techniques, which are based upon behavioral learning theory, emphasize the acquisition of knowledge through drills and repetitive practice (Binder, 1996). Students perform exercises of increasing difficulty, designed to teach them to understand new concepts, and become fluent in their use. Mastery learning techniques have been shown to be particularly effective in teaching the acquisition and retention of skills-based knowledge (Johnson & Layng, 1992).

Discovery learning, based upon Piagian/constructivist theories of learning, emphasizes the acquisition of knowledge through problem-solving and simulation. Constructivist theories of learning stress the importance of contextual learning, intrinsic motivation, and the individual construction of meaning (Roblyer, Edwards & Havriluk, 1997). Techniques based upon these theories seek to bridge the gap between the acquisition and application of knowledge (Schank, 1995). Rather than being told what concepts and principles they are expected to master, students are instead presented with a task to carry out, and a set of circumstances that requires they learn, through trial and error, what concepts and principles must be applied to achieve the desired outcome. Emphasis is placed upon creating a risk-free environment in which students can try out numerous approaches to a problem situation without experiencing negative consequences from that action (Schank, 1994). An atmosphere of experimentation is fostered so that failure becomes a context for learning, rather than a punitive circumstance to be avoided. Discovery learning approaches are particularly useful for teaching processes that may have multiple acceptable outcomes, or for engendering the

extrapolation of knowledge acquired in one context to another set of circumstances (Roblyer, Edwards, & Havriluk, 1997).

The principles of mastery and discovery learning form the basis for the design of effective multimedia learning environments. Through the application of these principles, institutions of higher education may increase the academic rigor of courses formerly taught primarily by lecture or self-paced student manuals (i.e. Keller-plan or correspondence courses). The limitations of these passive forms of instruction, whether delivered in the classroom or via a distance delivery medium, have been well documented (DeNeve & Heppner, 1997; Williams & Brown, 1991; Williams, 1996). Research demonstrating that the single most significant factor accounting for student learning is the amount of time spent in meaningful interaction with course content suggests that the single most effective means by which faculty can increase the academic rigor of their courses is through the development of interactive multimedia-based learning modules, either to replace or supplement other forms of instruction (Van Dusen & Worthen, 1995; Walberg, H. J., et. al., 1994; Worthen, Van Dusen & Sailor, 1994).

### Academic Departments and Multimedia Design

The development of these learning modules, however, presents a significant challenge to academic departments where faculty have little prior experience with either multimedia development or instructional design for active learning. Even if a few faculty members have developed familiarity with some of the skills required, and applied them in individual classes, meaningful curricular change will likely not have been affected. Significant curricular changes require a departmental effort, and include a re-examination of the goals and outcomes of a course. Curriculum committees, not individual faculty members, typically hold responsibility for redefining course objectives. Cohesive degree programs depend upon such coordination. This is particularly true of large undergraduate survey courses where multimedia instruction may be expected to have the most impact. The fact that such classes provide the knowledge-base for a large number of upper-level courses further identifies them as appropriate targets for multimedia enhancement. Yet such curricular change cannot happen until the number of faculty with the requisite knowledge of multimedia instructional design reaches a critical mass.

## Goals of Curriculum Redesign

### Curricular Goals

This was the dilemma faced in our college, when the decision was made to migrate our one-credit-hour, introductory course on library research skills from a self-paced, paper manual to a Web-based, multimedia platform. The LI110 undergraduate course on information literacy is part of the University of Nebraska-Lincoln's Comprehensive Education Program, and is required by most colleges for graduation. In addition, it provides the groundwork for all advanced instruction carried out by subject specialists in cooperation with their liaison departments. Our college's curriculum committee, the Library Instruction Program Group (LIPG), is responsible for the content of the course, yet most of the faculty on this committee lacked exposure to, and experience with, multimedia instruction. Although interested, they were unprepared to take on the challenge of redesigning LI110 for delivery via the Web. Nevertheless, with an enrollment of 3,500 students annually, and recognition that the

academic rigor of the course needed to be strengthened, the redesign of this curriculum was made a college priority.

The goals of the redesign effort were to:

- Increase the academic rigor of the course by:
  - clarifying curricular objectives;
  - improving student's mastery and retention of course-related knowledge and skills;
  - strengthening the relevance and motivational quality of exercises;
  - eliminating extraneous content.

- Utilize Web-based multimedia instructional techniques to:
  - make the course more accessible to students;
  - incorporate more active learning strategies;
  - increase student's information literacy skills;
  - improve the efficiency of administering and managing course delivery.

- Respond to criticisms of course content:
  - faculty perceptions that it was not rigorous enough;
  - student feedback that exercises did not adequately prepare them for exams;
  - departmental criticisms that students were not demonstrating transfer of training beyond the course.

**Faculty Development Goals**

A faculty development approach was adopted by the College to allow wider input to the redesign of the LI110 curriculum, and to foster the acquisition of multimedia instructional design skills by all faculty who chose to be involved in the redesign effort. A three-member team of faculty was formed to oversee the redesign effort. This Research & Development Team for Instructional Technologies (R & D Team) was charged with the dual task of infusing the college's instructional programs with appropriate technologies, and simultaneously developing the instructional technology skills of other faculty within the college. The process the Team developed for fostering faculty development and curricular redesign may be adopted by other academic departments to address similar needs of enhancing faculty skills and increasing academic rigor.

Several areas of faculty development were targeted through the redesign effort:

- Multimedia instructional paradigms and methods
- Principles of mastery and discovery learning
- Content analysis and formulating behavioral outcomes
- Formative and summative assessment strategies
- Flowcharting, screen design and storyboarding techniques

A series of faculty development workshops were sponsored by the team, both at the outset of the redesign project, and at strategic points throughout. Some workshops were developed in collaboration with knowledgeable faculty leaders in multimedia instructional design from other departments. In addition, a structured process was used to guide faculty through the steps of the redesign effort from identifying behavioral outcomes and conducting a content

analysis, through specifying the multimedia components and discovery learning scenarios to be implemented for each unit.

### Organizing for Curricular Redesign

The redesign work itself focused initially on two core units of the LI110 course. Two Redesign Groups, each consisting of four faculty members each, were formed to take responsibility for the two units. Each step of the redesign process was introduced in a workshop setting, and one member of the R&D Team met with each of the redesign teams throughout the duration of the project. Implementation of the redesigned curriculum is being carried out with assistance from a graduate research assistant knowledgeable in the tools of web-development. The formative and summative assessment portions of the redesigned course are being implemented using a cutting-edge testing utility developed by a UNL faculty member and being marketed by Wiley Publishers, Inc.

## Guiding the Redesign Process

### The Theoretical Basis

The first phase of the redesign process focused on providing members of the redesign groups with the theoretical basis for multimedia instructional design. Since the majority of faculty on the Redesign Groups had no prior exposure to multimedia instruction, we knew we would have to provide some stimulus to get our faculty thinking creatively about the possibilities. The R&D Team began by presenting a basic workshop entitled, "What is a Multimedia Learning Environment?" This workshop allowed us to:

- introduce the basic concepts of multimedia instruction;
- begin to build a common language for discussing multimedia design; and
- present examples of how selected aspects of the LI110 curriculum might be more creatively and effectively taught using a multimedia learning environment.

This presentation was followed by two hands-on workshops introducing the theoretical underpinnings of mastery and discovery learning. These workshops were developed and presented in collaboration with faculty members from the departments of psychology and physics, respectively. The workshop on mastery learning focused on behavioral models of learning, and the computer assisted instructional techniques derived from them, which seek to foster fluency by identifying and developing, incrementally, the component skills that make up complex behaviors. The workshop on discovery learning introduced constructivist theories of learning, and the scenario-based, problem-solving approaches to instruction they inspire. We wanted the members of the Redesign Groups to understand the learning theories upon which these two approaches to multimedia instructional design are based. Drawing upon the outside expertise of faculty at UNL who had experimented with the application of these approaches to learning in the design of multimedia instruction lent credibility to the approach we were asking our faculty to take in redesigning LI110.

### Putting Theory Into Practice

**Theory is not enough.** Perhaps naively, the R&D Team thought that after attending these workshops, the Redesign Groups would dive enthusiastically into the redesign of their respective units. When this did not happen, we realized that understanding theory was not

enough; our faculty needed a structured process for applying that theory to the redesign of our curriculum. So the R&D Team designed and presented a series of workshop in which we laid out a step-by-step process for taking our existing curriculum and rethinking it for multimedia delivery.

**Content analysis.** We knew that in order for this redesign effort to result in a more rigorous curriculum, we would have to challenge the members of the redesign groups to reconsider not only the method of instruction, but also the basic goals and objectives of the course. We therefore started with a detailed content analysis workshop in we provided guidelines for restating the goals of each unit in terms of meaningful behavioral outcomes. Building upon theory presented in the mastery learning workshop, we showed how these behavioral outcomes, which represent composite skills, could then be further analyzed into the component skills required to make them manifest. We emphasized that a clear and complete statement of the composite and component skills to be taught by each unit would serve as a guide throughout the design process for what should be covered, and at what level of detail. In doing so, we sought to ensure that the new curriculum would have greater focus, and contain less tangential material.

**Formative and summative assessment.** Once the Redesign Groups had carried out a detailed content analysis of their respective units, we introduced the conceptual and procedural knowledge required to develop formative and summative assessment instruments for each of the units. We wanted to tie this step as closely as possible to the content analysis in order to emphasize the correspondence between the two. One of the primary weaknesses of the existing curriculum was that the units often presented core concepts that were never assessed. Moreover, the exercises at the end of each unit did not adequately assist students in learning the knowledge and skills that were to be assessed on the final exam. Another limitation was that the existing curriculum provided no opportunities for students to practice the skills we were teaching, and to obtain feedback on their performance without consequence to their grade. The latter is, of course, the hallmark of mastery learning, and without it, students could not be expected to develop the fluency required to achieve a level of learning that would translate into enduring behavioral change.

**Content specifications.** The final faculty development workshop introduced faculty on the Redesign Groups to the basics of flowcharting, screen design, and storyboarding techniques, so that they could specify how the content of their respective units should be structured and presented. Since the behavioral outcomes of each unit had already been clearly defined, this phase of development consisted of outlining how the conceptual and procedural knowledge required to achieve those outcomes would be presented to students. Where mastery learning techniques were to be employed, this merely required that faculty specify the material to be presented prior to each formative assessment exercise. In addition, we reintroduced the principles of discovery learning, and asked the redesign groups to consider when a constructivist approach to learning might more effectively achieve the goals of the curriculum. In this case, the Redesign Groups were asked to outline the parameters of the problem-solving scenarios with which students would be presented.

## Outcomes of the Redesign Effort

### Curricular Quality

Throughout the redesign effort, the importance of three things was emphasized:

1. Bearing in mind the behavioral outcomes that defined the goals of the curriculum.
2. Considering the appropriate level of instruction for the population of students who would be taking the course.
3. Using the principles of mastery and discovery learning to design curriculum that would ensure students develop the component and composite skills required to master the behavioral outcomes.

It is evident from a comparison of the content and design of the original and redesigned curriculums, that the multimedia course aims at producing a higher level of understanding and performance among those who take the course, than did the manual-based course. Both the number and complexity of skills supported by the curriculum are increased in the redesigned course. Moreover, the new curriculum supports the development of all necessary component skills required to achieve the stated behavioral outcomes of the course. This was not the case with the original curriculum. In addition, the redesigned curriculum supports a greater variety of cognitive skills. The manual-based course developed students' comprehension and analysis skills only, while the redesigned, multimedia curriculum fosters comprehension and analysis, as well as application, prediction, deduction and problem solving.

Assessment methods also differ between the old and new versions of the course, with multiple choice tests being diversified to include true/false, matching and fill-in-the-blank questions. The effective use of formative assessment in the multimedia version of LI110 is perhaps the most dramatic change from the manual-based curriculum. Formative development of skills was poorly supported in the manual-based curriculum. The manual did not provide the type of feedback required to support mastery of component or composite skills. Moreover, chapter exercises emphasized composite skills, with component skills rarely being assessed. By ensuring an understanding of the theoretical bases of mastery and discovery learning, we enabled faculty to increasing the academic rigor of the course, using multimedia instruction. Since one of the challenges facing distance educators is to demonstrate that learning in a multimedia environment can be as effective as learning through traditional teaching methods, we look forward to the results of an empirical study of LI110 student outcomes, focused on assessing the skills levels of students completing the course.

### Faculty Development

We were equally interested in determining whether the faculty development goals of this curriculum redesign effort had been met. A structured interview was conducted with the members of the redesign teams toward the conclusion of the redesign effort, but prior to the implementation of the new curriculum. At this stage, faculty who had participated in the redesign groups expressed good understanding of the individual tasks they had carried out, but some were still having difficulty internalizing the process in a way that would allow them to apply it to other instructional activities. Some faculty were still struggling to master the specialized terminology of instructional design, others wondered whether the order of

design tasks might be varied. A few suggestions were offered for simplifying certain design tasks, and strengthening some aspects of the faculty development workshops. While not everyone saw the theoretical presentations on learning theory as equally valuable, most agreed that the structured analysis and design process had resulted in a deeper, more coherent, and well integrated curriculum. All had found the process enjoyable and challenging, and were eager to see their design specifications implemented.

Participants in the redesign process uniformly reinforced the value of the team approach to curriculum design, reporting that it kept creative energy high, and was necessary to ensure that the needs of different learners were addressed in the resulting curriculum. Most faculty indicated they would be willing to engage in this process again; some were eager for the opportunity to develop more fluency with the skills they had learned. A few were already considering opportunities to apply this instructional design process to other aspects of their instructional responsibilities. Even those faculty with years of experience in the classroom reported they had gained valuable theoretical knowledge, increased confidence and patience with curriculum design, and were eager to apply this process to other aspects of their teaching. This evidence suggests that the faculty involved in the redesign project will continue to use what they learn. The R&D Team plans to support additional multimedia development projects in our college in the coming year.

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### Autobiographical Sketches

**Gail F. Latta** is Associate Professor and Leader of the Research & Development Team for Instructional Technologies. She also serves as Faculty Associate for Instructional Technologies for the Teaching and Learning Center, where she coordinates a campus-wide faculty development series devoted to showcasing innovative applications of technology for teaching and learning. She is the incoming Chair of the campus Teaching, Learning & Technology Roundtable (TLTR), and President-elect of the UNL Academic Senate.

Address: 203 Don L. Love Library
University of Nebraska-Lincoln
Lincoln, NE 68588-0410
Email: glatta@unl.edu
Phone: (402) 472-2521
Fax: (402) 472-5131

**Tracy Bicknell-Holmes** is Associate Professor and Business Liaison Librarian at the University of Nebraska-Lincoln. She earned her Masters of Library and Information Science at the University of Illinois, and her Masters in Business Administration from the University of Nebraska-Lincoln. As a member of the Libraries' Research and Development Team for Instructional Technologies, she has been working to integrate multimedia technology into instruction at UNL, and has played an integral part in curriculum redesign of the Library Instruction 110 course.

Address: 219N Don L. Love Library
University of Nebraska-Lincoln
Lincoln, NE 68588-0410
Email: tracyb@unllib.unl.edu
Phone: (402) 472-2554
Fax: (402) 472-5131

**Sara Martin** is an Assistant Professor and Assistant Systems Librarian at the University of Nebraska-Lincoln, where she is responsible for developing and maintaining the computer skills training program for library faculty and staff. She is also an active member of the Research and Development Team for Instructional Technologies. Sara's prior professional experience included Head of cataloging and interlibrary loan for the Nebraska Library Commission and OCLC Member Services Coordinator for the State of Nebraska.

Address: 219N Don L. Love Library
University of Nebraska-Lincoln
Lincoln, NE 68588-0410
Email: saram@unllib.unl.edu
Phone: (402) 472-2485
Fax: (402) 472-5131